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INSECTS ATTACKING SQUASH, CUCUMBER, AND ALLIED PLANTS IN CONNECTICUT.

By W. E. Britton.

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December, 1919.

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Insects Attacking Squash, Cucumber and Allied Plants in Connecticut.

By W. E. Britton, *Entomologist.*

A paper on this subject was published in the report of this Station for 1908, page 805, but it has long been out of print. The present paper follows the plan of the earlier one, but has been revised, enlarged, and wholly rewritten, and is published in this form so that the information can be placed in the hands of truck crop growers throughout the state.

For the past five years, cucurbitaceous plants have been grown each year at the Station farm at Mount Carmel for the purpose of studying the insects attacking them and methods of control. Consequently this paper is more than a compilation, and embodies the results of our own experiments and experience.

Cucumbers, squashes, pumpkins and melons are grown rather extensively in Connecticut, and are attacked and often severely injured by a number of insect pests. For the hasty identification of these insects the reader is referred to the following key revised from the earlier paper mentioned above:—

KEY TO INSECTS OF SQUASHES, PUMPKINS, CUCUMBERS AND MELONS.

PAGE

Boring in the roots and stem—

Small, slender larvae tunneling in the main root or stem below ground

Striped cucumber beetle, *Diabrotica vittata* 34

Large, stout larvae boring in squash stems above ground

Squash vine borer, *Melittia satyriniformis* 39

Devouring the stem and leaves—

Small (1.2 mm.) purplish jumping springtails

The garden flea or springtail, *Sminthurus hortensis* 37

(2 mm.) black jumping beetles feeding upon the young leaves

Cucumber flea beetle, *Epitrix cucumeris* 38

Larger (5-7 mm.) yellowish beetles feeding upon the leaves.

Body yellow, marked with three longitudinal black stripes

Striped cucumber beetle, *Diabrotica vittata* 34

Body greenish yellow, marked with twelve black spots

Twelve-spotted cucumber beetle, *Diabrotica xii-punctata* 37

Large (8-10 mm.) hemispherical beetle, orange, marked with black spots, or yellow larva with black spines

Squash lady-beetle, *Epilachna borealis* 42

Sucking sap from the under side of the leaves—

Small dark green or brownish plant lice, often very abundant
Melon aphid *Aphis gossypii* 47

Larger bright green plant lice usually not abundant
Squash aphid, *Macrosiphum cucurbitae* 49

Grayish-brown bug with spicy odor (15 mm. when full-grown)
Squash bug, *Anasa tristis* 44

Small greenish-white scale-like insects on the under leaf surface of plants growing under glass or near greenhouses. Pure-white moth-like adults resting on the leaves, and flying about
Greenhouse white-fly, *Asterochiton vaporariorum* 50

CHEWING INSECTS.

The Striped Cucumber Beetle.

Diabrotica vittata Fabr.

As soon as the plants appear above the surface of the ground, and sometimes before, they are attacked as shown on plate I, c, by small beetles, striped lengthwise with yellow and black. These

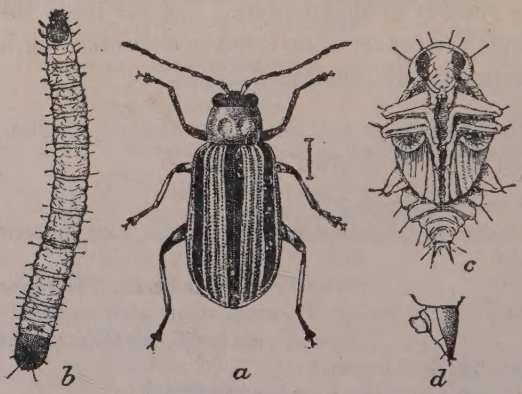


Figure 7. The striped cucumber beetle: *a*, adult beetle; *b*, larva; *c*, pupa; *d*, side view of anal segment. All greatly enlarged. (After Chittenden, Circular 31, Bureau of Entomology, U. S. Department of Agriculture.)

beetles eat away the tender tissue of seed leaves and young stems, often killing the plants unless treatment is given. They are about one-fifth of an inch (5 mm.) in length, with thorax and wing-covers yellow, with head and three longitudinal stripes, black. See figure 7, and plate I, b.

At the time the beetles are feeding they are also mating and the females lay eggs around the stem, just below the surface of the ground. These eggs are shown on plate I, a. The larvae hatching from them are slender whitish grubs with black heads, which tunnel in the roots or main stem in the ground, sometimes causing considerable injury, as shown on plate II, though probably this injury is less than that caused by the adults. The tunnels afford entrance for the wilt diseases which are often serious. The white pupa stage lasts about a week and occurs in the ground. There are two generations each year in the South, but only one in Connecticut, and the winter is passed by the adult beetles in the ground. Late in the summer the beetles are often abundant and feed upon the flowers of squashes and cucumbers and also upon goldenrod and other native flowers. They are often found resting in the curled leaves of the old vines.

One parasite, a Tachinid fly, *Celatoria diabroticae* Shimer, has been reared from the striped cucumber beetle in California and Texas.

METHODS OF CONTROL.

Control methods in vogue against this insect may be classified as follows:—

(1) Cultural practices.
(2) Covering the plants.
(3) Applying poisons or repellents.

(1) Cultural practices consist of crop rotation, the use of quick-acting fertilizers to force plant growth, plowing, destroying old vines, time of planting, and the use of trap crops. Some of these need no explanation. It is advisable where possible, to plant the seeds in berry baskets or paper pots under glass and set them in the field when they are five or six inches tall as they are not so liable to be destroyed. Deep plowing in the spring will expose many hibernating adults which may be killed before they have a chance to attack the vines. As soon as the crop has been harvested in the fall, the vines should be gathered and burned to kill the insects resting on them. A light harrowing of the ground immediately afterwards will kill many of them.

Trap crops of squash or beans may be planted early around the field to attract the beetles. These can then be poisoned and

many of the beetles will be killed before the regular crop is ready to be attacked.

(2) The hills may be covered with plant protectors of wire cloth or cheese cloth to keep the beetles away from the plants. Cloth covered protectors are for sale on the market, or may be made at home by cutting a barrel hoop in two equal parts and fastening the centers of the two pieces together at right angles, setting the ends in the ground and covering with cheese cloth or mosquito netting. Still better, fasten the ends of the semicircular pieces to another hoop lying horizontally and cover the whole with netting to make a portable frame protector. As soon as the plants fill the protectors, the protectors may be removed and stored, for the following season. The cloth will usually last about two years, possibly three, then the frames will need recovering. It is often necessary to mend or patch the netting when small holes get torn in it. Boxes and various other forms of wood and netting may be adapted for service as plant protectors, but they are for use in the home gardens.

All forms of plant protectors must be placed over the hills before the beetles appear. Factory-made protectors are shown on plate III, c.

(3) Most commercial growers apply poison to the young plants as a protection. Lead arsenate is perhaps the best for this purpose, and it may be used as a spray or as a dry powder. The beetles do not like to come out of the ground through a layer of dry powder, and a heavy application of dry arsenate of lead is usually effective. If the plants are sprayed, it is essential that the under surface of the leaves be coated or the beetles will congregate there and eat away the substance of the plant. Where cucumbers are grown, it is advisable to spray them with Bordeaux mixture to which lead arsenate may be added at the rate of two ounces of the paste or one ounce of the dry powder to one gallon of the liquid.

Various other dry powders, such as air-slaked lime, gypsum or land plaster, and soot, freely dusted upon and around the plants are of considerable value in controlling the striped cucumber beetle.

The Twelve-Spotted Cucumber Beetle, or Southern Corn Root Worm.

Diabrotica xii-punctata Oliv.

Though having a long list of food plants, including nearly all of the common vegetables, and not usually considered as a particular pest of cucurbitaceous plants, it has been so abundant in certain fields in some seasons that considerable damage must have resulted from it. In the South, the larvae are a serious pest of corn roots, and it is called the corn root worm. It also attacks rye, millet, and garden beans, often doing considerable damage.

The adult beetle shown on plate III, a, is somewhat larger and stouter than the striped cucumber beetle, and averages about 7 mm. in length. The wing-covers are greenish-yellow, marked with twelve black spots varying in size and arranged in three transverse rows. The thorax is bright yellow and the head black. The legs, except basal half of thighs, and the antennae are blackish; basal half of thighs greenish-yellow.

The life history is similar to that of the striped beetle, each female laying two or three hundred eggs in the soil. These eggs hatch in from one to three weeks, and the larvae tunnel in the roots of corn and other plants, becoming mature in from two to five weeks: then they pupate in earthen cells in the ground, the beetles emerging a week or two later.

When abundant this insect can be controlled in the same manner as the striped cucumber beetle.

The Garden Flea or Springtail.

Sminthurus hortensis Fitch.

Small seedling plants of many kinds are occasionally injured by very small jumping flea-like purplish insects which swarm in the soil and eat small holes in the leaves and stems, sometimes killing the plants. If the plants reach several inches in height and produce their second leaves, they will not be injured by these springtails.

The garden flea or springtail is about one-twentieth of an inch long, dark purple with pale yellow spots, and at the tip of the

abdomen there is borne a peculiar forked appendage by means of which it jumps.

This is one of the lowest forms of insects, and is very abundant for two or three weeks just as the seedlings are coming up.

Dusting with insect powder or ground tobacco is suggested as a remedy. Spraying with nicotine would doubtless kill great numbers of the springtails.

The Cucumber or Potato Flea-Beetle.

Epitrix cucumeris Harris.

The seedling plants of cucumbers are often attacked and injured by a small black jumping beetle which eats holes in the leaves. This is the same pest that commonly injures potato, tomato, egg-plants and tobacco in Connecticut fields and is shown in figure 8. It is about one-sixteenth of an inch in length, legs and antennae are yellowish, wing-covers and thorax, jet black.

Figure 8. The cucumber flea beetle *Epitrix cucumeris,* greatly enlarged. (After Chittenden, Bureau of Entomology, U. S. Department of Agriculture.)

The adult beetles live through the winter under leaves and rubbish and the eggs are laid in May and June. The larvae are white thread-like worms which feed upon roots and therefore live and transform beneath the surface of the ground. Probably there are two, and possibly three, generations each year.

Flea beetles may be killed by arsenical sprays; driven away by repellents; or trapped by mechanical devices.

Ordinarily the application of lead arsenate to control the striped cucumber beetle will also control flea-beetles. Bordeaux mixture

is recognized as a repellent by gardeners, and may well be applied with the lead arsenate as it is needed to control certain fungous diseases and should be sprayed against both upper and under surfaces of the leaves.

Insect powder, one pound in ten gallons of water, or lead arsenate mixture in which gelatine has been incorporated gave the best results in tests in 1914 at the New Jersey Station.*

For controlling flea-beetles on potatoes, Prof. C. L. Metcalf devised a sticky box or trap which has been described,† but which is hardly necessary to consider in connection with cucurbitaceous plants. The application of lead arsenate will usually be found sufficiently effective.

The Squash-Vine Borer.

Melittia satyriniformis Hubn.

With the possible exception of the striped cucumber beetle, which is occasionally very destructive, the squash-vine borer is the most important pest of squashes and pumpkins in Connecticut. This insect causes the vines to wither in July and August, and to die before maturing their crop. Cucumbers and melons are seldom attacked if squashes and pumpkins are plentiful in the neighborhood.

The larva or borer tunnels in the main stem near the surface of the ground as shown on plate IV, and decay sets in often involving the whole stem which frequently becomes entirely severed, thus shutting off the supply of sap to the plant. The wilting is usually the first sign of attack, though an earlier examination would show the yellow pellets of frass or excrement which are thrown out of holes in the stem.

The adult is one of the clear-wing or Sesiid moths having a wing-spread of from one to one and one-fourth inches. The fore wings are opaque dark olive-green with a metallic luster and a fringe of brownish-black. The rear wings are transparent with a bluish reflection, and veins and fringe are black. The thorax and antennae are colored about like the fore wings, with

* Report New Jersey Agricultural College Experiment Station for 1914, page 378.

† Journal of Economic Entomology, Vol. 8, page 240, 1915: Report Conn. Agr. Expt. Station for 1918, page 105.

abdomen reddish-brown, legs bright orange and tarsi black with white bands. When at rest the wings are folded horizontally as shown in figure 9, b.

The egg is about one millimeter in diameter, oval in outline, flattened at the point of attachment, and is dull red in color. The female may lay two hundred or more eggs, and at first these are deposited singly on the stem of the vine near its base during June or early July in Connecticut. Later in the season, the eggs may be laid at almost any point on the plant and the borers are often found in the leaf petioles. From six to fifteen days are

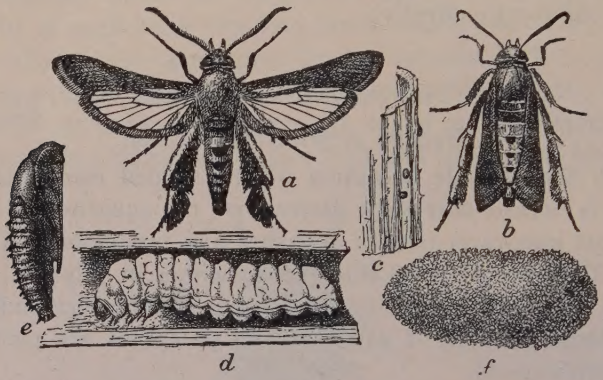


FIGURE 9. The squash borer: *a*, male moth; *b*, female, with wings folded as when at rest; *c*, eggs on section of squash stem; *d*, full-grown larva in the stem; *e*, pupa; *f*, pupal cell. All one-third larger than natural size. (After Chittenden, Circular 38, Bureau of Entomology, U. S. Department of Agriculture.)

required for the eggs to hatch and the young larvae enter the stem and begin their depredations, usually working toward the root, but frequently going in the opposite direction. Later in the summer the larvae may be found tunneling in all parts of the stem, leaf petioles and even in the fruit. The mature larva is a fat white grub, with black head, and is about an inch in length. When ready to transform it goes into the ground one or two inches below the surface, and spins a tough brownish cocoon, into the outer layer of which particles of soil are fastened. This cocoon is about three-fourths of an inch long. In Connecticut the caterpillars remain in their cocoons until the following season.

There are two broods in the South but only one in Connecticut. Between the latitudes of Long Island and Washington, D. C., there is a partial second brood.

The pupa is about five-eighths of an inch in length, is dark brown, and its head bears a sharp horn-like projection by means of which it cuts its way out of the cocoon.

This insect occurs throughout the eastern half of the United States from Canada south to Mexico and into South America.

METHODS OF CONTROL.

The application of arsenical and contact insecticides are of no avail against this insect. Cultural practices must be relied upon to hold it in check, and are as follows:—

(1) Plant early squashes as trap crops to be destroyed later.
(2) Cut out the borers with a knife.
(3) Cover the vines with soil to induce the growth of new roots.
(4) Collect and burn the old vines as soon as the crop is harvested.
(5) Crop rotation.

(1) In some localities growers have been successful in planting early varieties such as crooknecks between the rows or around the margins of the field. The moths will lay their eggs on these plants which can later be pulled up and burned. The main crop appearing later will escape the larger part of the infestation.

(2) Wherever a plant has become infested, a careful cut lengthwise the stem with a small, sharp knife will disclose the borer, which can then be killed with the knife. A careful examination of the basal portion of the vine will disclose the presence of a borer, as the yellow frass is always thrown out through a hole in the side of the stem. Such an examination should be made early in July and repeated several times during the month and even in August. If the vine has not been seriously injured and decay has not set in, the incision will heal.

(3) As there is always danger that a borer may be overlooked, each vine should be covered with soil at a point two or three feet from its base after it is well started running along the ground. New roots will be formed at this point and even if decay

wholly destroys the stem at its base the new roots enable the plant to keep on and mature its crop. The writer has seen a squash vine yield a good crop, when treated in this way, where the main stem was entirely severed from its root system.

(4) As the moths do not all appear at the same time, the egg-laying period extends over a long time or perhaps the greater portion of the summer. Consequently, larvae may be present somewhere in the vines late in the season. Gathering and burning the vines after the crop has been harvested will destroy many of these larvae which have not gone into the ground to pupate.

(5) As the squash-vine borer hibernates in the ground, it is advisable not to grow squashes on the same field year after year.

The Squash Lady-Beetle.

Epilachna borealis Fabr.

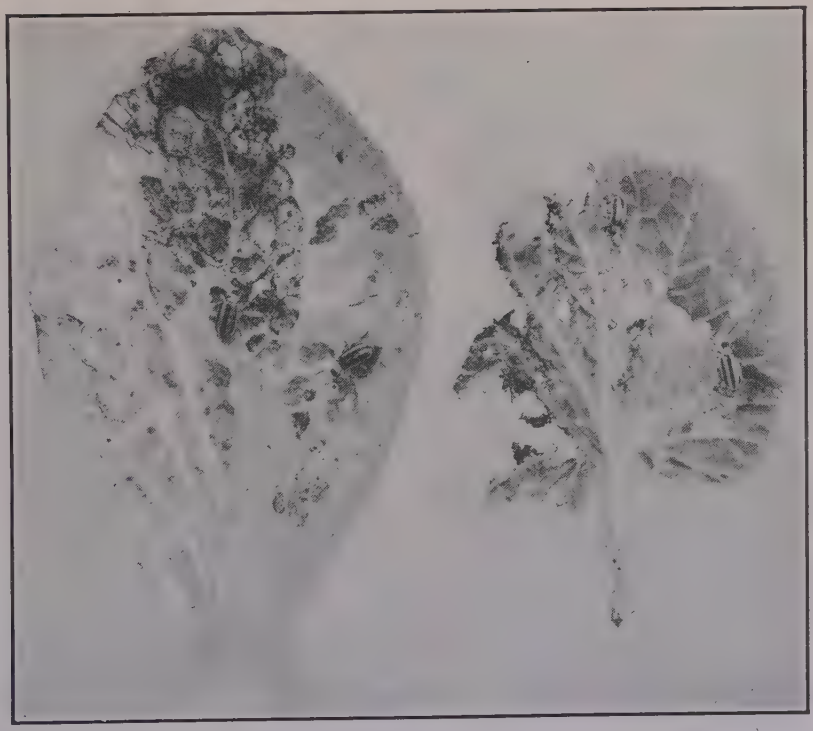
Though nearly all of the lady-beetles are carnivorous and therefore beneficial because they feed upon and destroy injurious insects such as aphids and scale insects, there is one exception in

Figure 10. The squash lady-beetle: *a*, larva; *b*, pupa; *c*, adult beetle, three times natural size; *d*, egg, four times natural size; *e*, surface of same highly magnified. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

Connecticut in the squash lady-beetle. This species (both adults and larvae) feeds upon the leaves of cucurbitaceous plants but does more injury to squash than to the other plants of this group. The adult beetles pass the winter under the bark of dead trees,

a. Eggs, as laid in the soil. Five times enlarged.

b. Striped cucumber beetle. Enlarged four times.



c. Work of the striped cucumber beetle. Natural size.

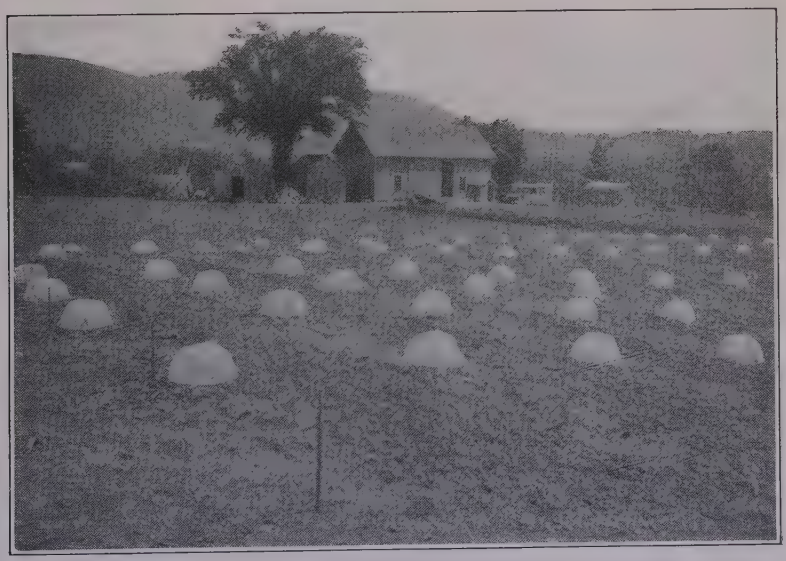
STRIPED CUCUMBER BEETLE.

PLATE II.

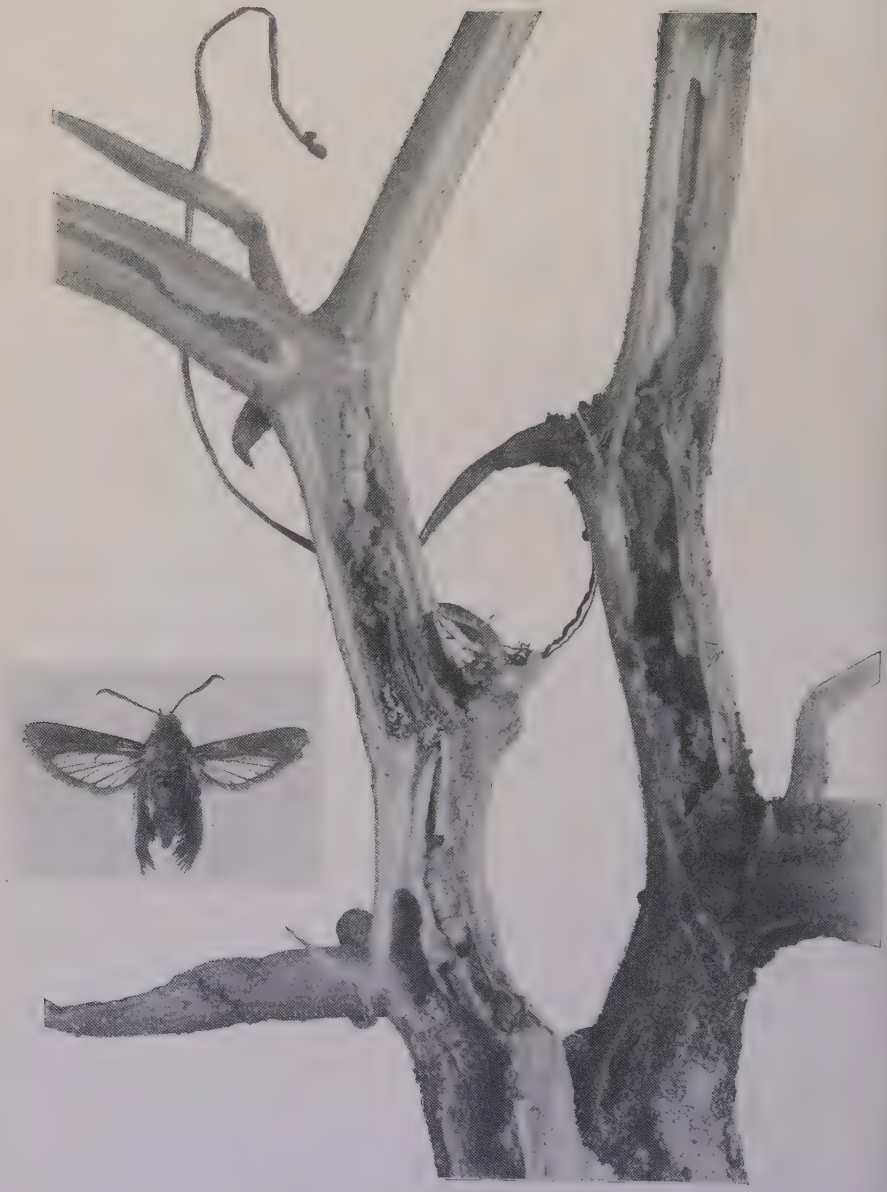
Cucumber plants injured by the larvae of the striped beetle.
Natural size.

a. Twelve-spotted cucumber beetle. Enlarged four times.

b. Eggs of squash-vine borer.

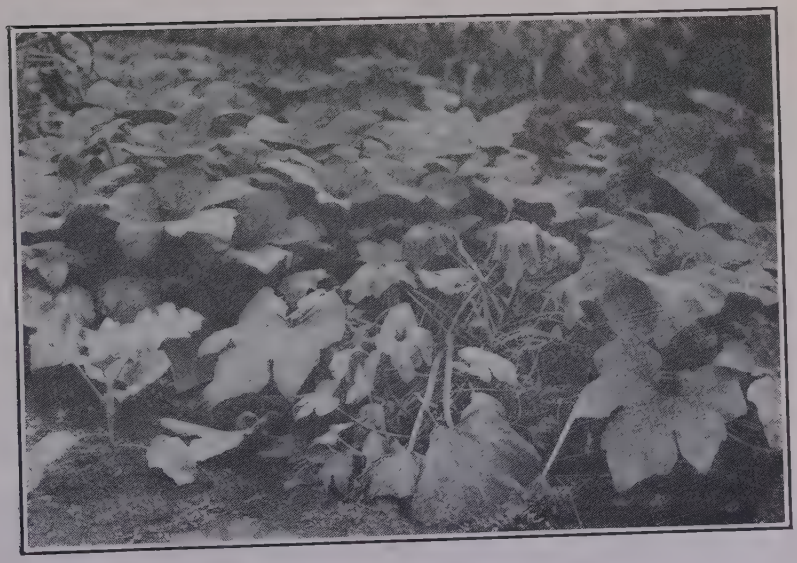


c. View at farm showing protectors over cucumber plants.

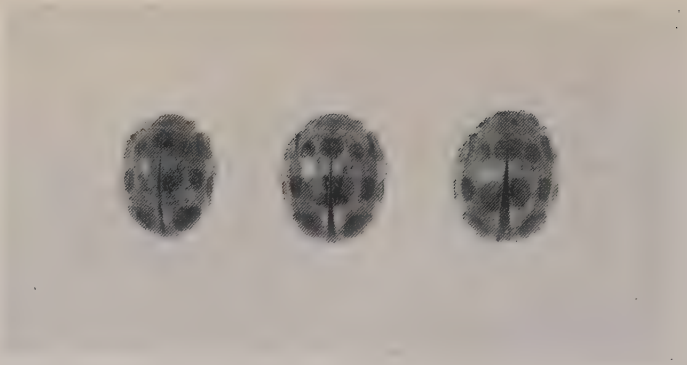


SQUASH BORER: ADULT AND WORK OF LARVAE IN SQUASH STEMS.
Slightly enlarged.

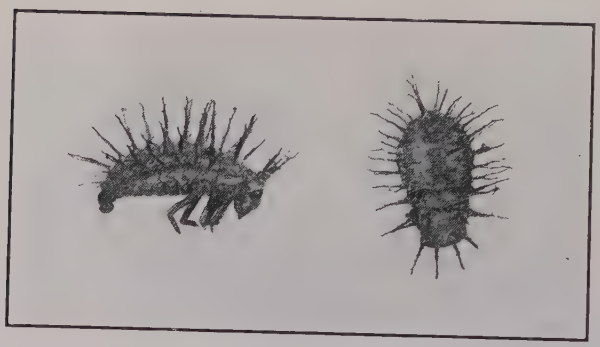
a. A field of healthy squash vines.



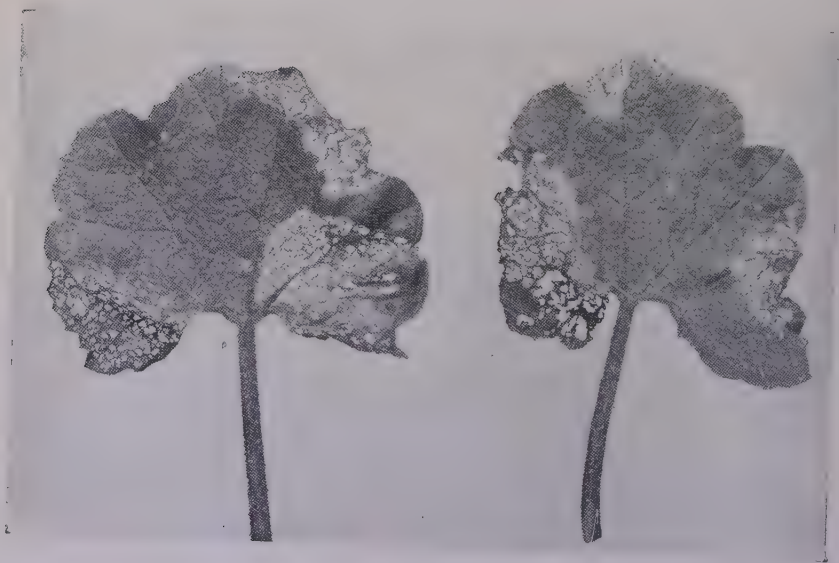
b. Vine wilting from the attacks of the squash-vine borer.



c. Squash lady-beetle. Twice natural size.



b. Larva of squash lady-beetle. Enlarged.



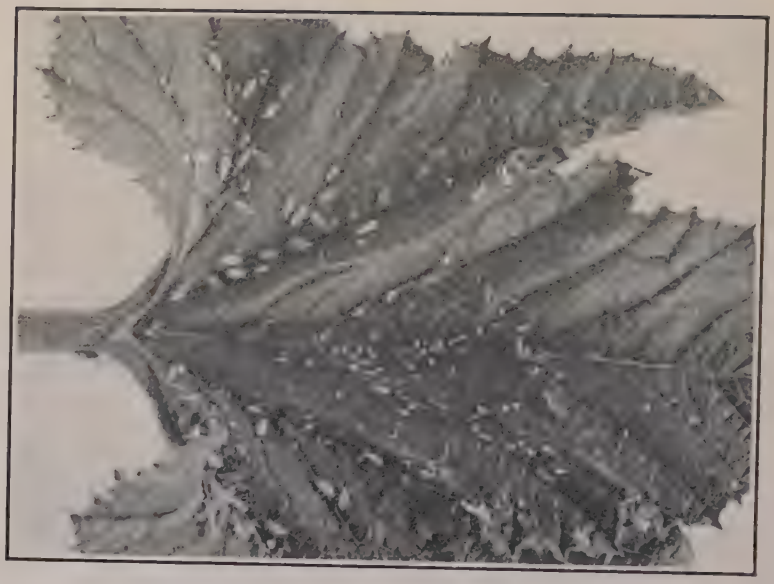
c. Work of the squash lady-beetle. Greatly reduced.

SQUASH LADY-BEETLE.

a. Squash bug. Twice natural size.

b. Eggs and young squash bugs. All natural size.

SQUASH BUG.



a. The potato aphid on squash leaf. Natural size.

b. Greenhouse white-fly. Adults and pupa skins. Enlarged four times.

stumps, etc., or other sheltered places, emerging in June and laying their eggs on the under surface of the squash leaves, These hatch in about twelve days and the larvae begin to feed upon the under side of the leaves. The larvae appear in Connecticut about the middle of July and become fully grown in about three weeks or early in August. The larva is about three-eighths of an inch in length, yellow, with six rows of long black branched spines. The pupa is yellow and like those of its kind is attached by the tail to the under surface of the leaf: it lasts from six to nine days. There is only one generation each year. All stages of this insect are shown in figure 10; adults and larvae on plate VI.

Though the larvae are found feeding upon the under side of a leaf in July and August, the adults are generally present at the same time as well as earlier and later, feeding upon the upper surface. The adult has the peculiar habit of marking out with its mandibles a definite area on the leaf, and then feeding within this area. This form of injury is shown on plate VI, c. The squash lady-beetle is usually a minor pest being present only in small numbers; handpicking is generally the best method of control in such cases. If abundant the vines should be sprayed with lead arsenate, using perhaps two pounds of the paste in fifty gallons of water.

Other Chewing Insects.

Cutworms.—The small plants are often eaten off by cutworms, which are the larvae of several species of Noctuid moths. In small plantations these can be hunted and crushed, but in large fields where cutworms are destructive, the following mash should be employed:—

Wheat bran	5 pounds
Paris green or white arsenic	5 ounces
Lemon or orange	1 fruit
Molasses	1 pint
Water	7 pints

Mix the dry poison and bran together. Squeeze the juice from the orange or lemon into the water and also add the pulp and peel cut in small pieces: then add the molasses and stir. Mix the syrup thoroughly with the poisoned bran. This will make a rather dry mash which may be scattered thinly over the field

at the time when the injury is first noticed. As the cutworms feed at night, the mash should be applied just before dark: the cutworms will be attracted by the fresh citrus juice and molasses. If allowed to become dry before night, it will have lost in some measure its attraction for the cutworms. Late fall plowing and very thorough harrowing will reduce the numbers of cutworms.

Wireworms.—These are the larvae of click beetles and often are so abundant as to injure various crops. They are slender, hard, cylindrical grubs usually smooth and shiny and light brown in color. They injure plants by tunneling in the roots, especially the main stem below the surface of the ground. Crop rotation, fall plowing and thorough harrowing are the best preventives.

In the South, the pickle worm *Diaphania nitidalis* Stoll, and the melon worm *Diaphania hyalinata* Linn., cause much injury to crops of melons, cucumbers and squashes, but though they occur in Connecticut, they are rare and seldom are found feeding upon these plants in cultivated fields. Planting a succession of summer squashes at intervals of two weeks as trap crops seems to be the best method of controlling these insects.

Certain other general feeders sometimes attack squashes and cucumbers. The stalk borer *Papaipema nitela* Guen. was found by the writer in the stem of a melon plant in 1918. Various caterpillars of the families Noctuidae and Arctiidae occasionally feed upon the blossoms, leaves or young fruit, but can scarcely be considered as pests of the crop in Connecticut.

SUCKING INSECTS.

The Squash Bug.

Anasa tristis Degeer.

The squash bug, or "stink bug," is an important pest of squashes and pumpkins, though as a rule it does not injure cucumbers and melons in Connecticut. It injures the plants by puncturing the tissues of a vein on the under side of a leaf, and sucking out the sap. This causes the leaf to wilt badly and die. Frequently all the leaves on a vine wilt from the attacks of these bugs and the entire vine dies.

The range of this insect covers the entire United States, and is from Canada to Central America. The adult bugs hibernate

in any convenient place where they can find shelter, such as in old vines and rubbish, under loose bark, boards, etc., and emerge late in the spring and attack the young plants. In addition to their punctures and withdrawal of sap from the plant, it is

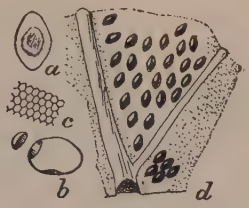


FIGURE 11. Eggs of squash bug as they are laid on the under side of a leaf. Enlarged. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

thought that some poisonous substance is injected into the wound. A few punctures are sufficient to kill a small plant.

The female bugs lay on the under side of the leaves, dark brown shiny eggs in clusters containing between twenty and forty each, arranged in more or less regular rows, often in the

FIGURE 12. Nymphs of the squash bug; different stages, about twice natural size. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

forks of veins, as shown in figure 11. From six to fifteen days afterward, these eggs hatch and the young nymphs remain together on the under side of the leaf where the egg cluster was laid. They are at first green with pink head, legs and antennae,

but after the first molt, they are ash-gray in color. They molt five times during the nymphal period of four or five weeks, during which they are sucking the sap from the plants. The nymphs are shown in figure 12, and on plate VII, b.

The full-grown bug is about five-eighths of an inch long, dark grayish-brown in color, and when not feeding or laying eggs, the adults and larger nymphs gather round the base of the plant or under clods of earth. Frequently they congregate on the immature fruits, especially where the foliage has been killed by frost before the nymphs reach maturity. There is only one

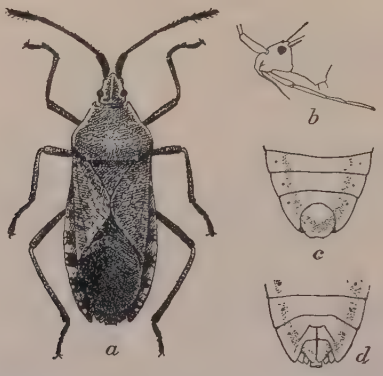


FIGURE 13. The squash bug: *a*, mature female, twice natural size; *b*, side view of head showing proboscis; *c*, abdominal segments of male; *d*, same of female. Enlarged. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

generation each year. Adults are shown in figure 13, and on plate VII, a, and the beak or sucking mouth in figure 14.

In the South there are two other species of this genus which are associated with the squash bug and cause similar injury to the plants though less abundant. In the southern states, the southern leaf-footed plant bug *Leptoglossus phyllopus* Linn. injures melons and various other vegetable crops, and in the central states, the northern leaf-footed plant bug *Leptoglossus oppositus* Say, occasionally attacks cucurbitaceous plants, but these insects have not been recorded from Connecticut.

Methods of Control.—The adults are hard to kill and such methods as the burning of all old vines and rubbish around the

field, trapping under boards and handpicking are the means of destroying them. Egg-masses on the leaves may be crushed, or scraped off with the edge of a knife. The nymphs, especially the younger ones, may be killed by spraying with kerosene emulsion,

FIGURE 14. Squash bug. Enlarged view showing head and proboscis.

or with nicotine solution, two teaspoonfuls in a gallon of water, to which an inch cube of laundry soap has been dissolved and added. In applying any spray to kill the nymphs, it is necessary to use an upturned nozzle in order to direct the spray against them on the under side of the leaves.

THE MELON APHID.

Aphis gossypii Glover.

This is one of the most troublesome insect pests of cucumbers and melons throughout its range over the eastern half of the United States and southward into Brazil. In Connecticut it is present in nearly every field of cucumbers and melons, and being on the under side of the leaves, it escapes notice until the leaves begin to curl on account of its attacks. It is much less troublesome on squashes and pumpkins, but has a long list of food plants, including many of our common vegetables, and cotton in the South. It is apparently able to subsist on a large number of common weeds, though its complete life history is still unknown. Whether it produces winter eggs, or each year migrates from the South, or lives over in greenhouses is still a matter for specula-

tion. It is able to multiply so rapidly that plants are often injured in a short time. The infested leaves curl backward or downward, making it very difficult to reach the aphids with a spray. The melon aphid is shown in figure 15. It is preyed upon by our common lady-beetles, larvae of syrphid flies, lace-

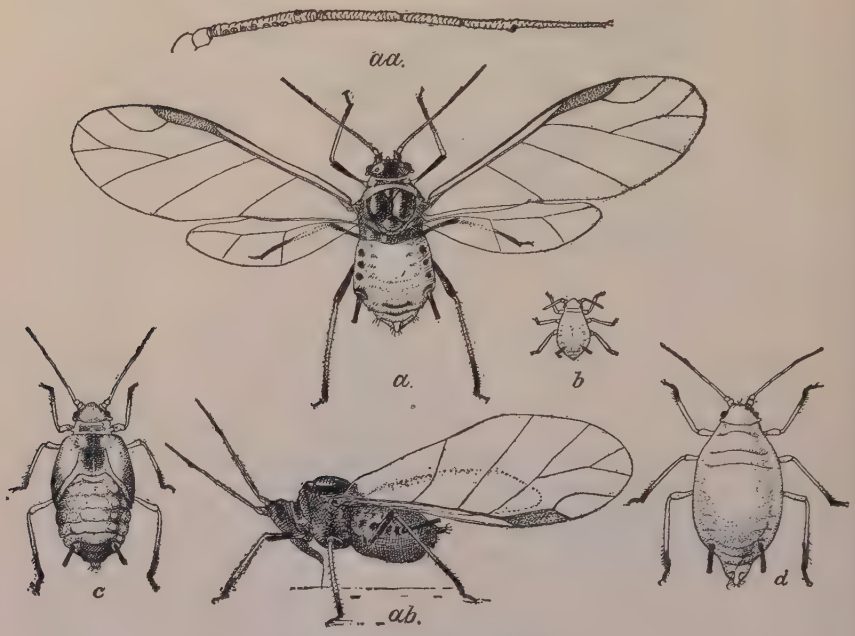


FIGURE 15. The melon aphis: *a*, winged female; *aa*, enlarged antenna of same; *ab*, dark form, side view; *b*, young nymph; *c*, last stage of nymph; *d*, wingless female. All greatly enlarged. (After Chittenden, Circular 80, Bureau of Entomology, U. S. Department of Agriculture.)

wing flies, and several species of parasitic four-winged flies aid in holding it in check.

Control.—In small gardens the vines can be watched and when the aphids first appear, the vines should be sprayed or fumigated to kill them. For fumigating, covers can be made by stretching table oilcloth over light wood frames. Each frame should be large enough to cover a hill, and either carbon disulphide (bisulphide) one teaspoonful to each cubic foot of space, or tobacco fumes may be employed as a fumigant. The former should be

placed in a shallow dish or saucer under the cover. Tobacco fumes may be obtained by burning tobacco stems, or some preparation of nicotine and paper.

In spraying, either kerosene emulsion or nicotine solution may be used, and the nozzle should be upturned by using a rod bent near the nozzle. The spraying operation will be facilitated by training all vines to run along the rows instead of across them.

If nicotine solution is used, it should be in the proportions of one-half pint of "Black Leaf 40" in fifty gallons of water, to which about three pounds of laundry soap has been dissolved and added.

Kerosene emulsion may be prepared as follows

Laundry soap (about 30 oz.)	3 cakes
Kerosene	3 gallons
Water	2 gallons

After churning, dilute eight times to make one barrel (50 gallons.)

The soap should be cut into thin slices and dissolved in hot water over a fire. Then remove from the fire, add the kerosene and churn vigorously for a few moments by passing the liquid through a spray pump having a small opening in the nozzle, and the stream directed back into the container. This makes a uniform creamy mass from which the oil does not separate on standing. Then dilute with the necessary amount of water and spray against the under surface of the leaves.

In all spraying operations a good pressure should be maintained, and a fine nozzle used. In commercial plantations, sometimes the first plants found to be infested are pulled up and buried or burned to kill the aphids. Dusting with insect powder or fine tobacco dust applied with a powder gun is also practiced in some cases. In any event, the treatment should be given before the leaves have curled as it is difficult afterward to hit the aphids.

The Squash Aphid.

Macrosiphum cucurbitae Middleton.

This is a light green aphid, considerably larger than the melon aphid, but is never as abundant and therefore never as destructive as that species.

The Potato Aphid, *Macrosiphum solanifolii* Ashm., was found on squash at the Station in 1909 and again in 1914. It is shown on plate VIII, a.

Both the aphids mentioned above, if sufficiently abundant to warrant the outlay, may be controlled by the same methods advised for the melon aphid.

The Greenhouse White-Fly.

Asterochiton (Aleyrodes) vaporariorum Westwood.

Cucurbits growing under glass or out of doors near greenhouses are often attacked and considerably injured by the greenhouse white-fly. The white moth-like adults are found resting on the under sides of the leaves where they lay eggs and where the nymphs also occur. The eggs are very small, ovate, whitish, and are attached to the leaf by a short stalk at the larger end. The nymphs are oval, flat, light green, and resemble scale-insects. The empty pupa skins are silvery white and adhere for a long time to the leaf. The adults are pure white and in appearance look as if sprinkled with flour. This insect is shown on plate VIII, b, but a more detailed description may be found in the Reports of this Station for 1902, page 148, and for 1906, page 275.

The same treatment recommended for the melon aphid will control the greenhouse white-fly. Spraying with soap and water (common laundry soap, one pound dissolved in eight gallons) is also effective.

In greenhouses it is often advisable to fumigate the entire house with hydrocyanic acid gas, using one-half ounce of cyanide for each thousand cubic feet of space with an exposure of three hours. This is by far the most effective of all treatments. If spraying is depended upon to hold the pest in check it must be repeated frequently.

Summary.

Chewing insects which attack and injure squash, pumpkin, cucumber and melon plants in Connecticut are the striped cucumber beetle, the squash-vine borer, and occasionally the twelve-spotted cucumber beetle, the cucumber flea beetle, the garden flea or springtail, the squash lady-beetle, cutworms and wire-

worms. The striped and twelve-spotted beetles can be controlled by covering the plants with netting, or by spraying or dusting them with lead arsenate. The cucumber flea-beetle and the squash lady-beetle may likewise be controlled with lead arsenate.

To control the squash-vine borer, plant early squashes as a trap crop to be destroyed later: cut out the borers with a knife: cover the stems of the vines with soil to induce the formation of new roots: collect and burn all the old vines as soon as the crop is harvested. Cutworms can best be controlled by the use of a poisoned bran mash, and wireworms by fall plowing and rotation of crops.

The most troublesome sucking insects on cucurbits in Connecticut are the squash bug and the melon aphid. Minor pests of this nature are the squash aphid, potato aphid, and greenhouse white-fly. All of these pests can be controlled by spraying at the right time with nicotine solution and soap, with kerosene emulsion, or by fumigating.

Gathering and burning the old vines and other rubbish on the field after the crop has been harvested is a worthy practice and will tend to reduce the numbers of all insects attacking the crop.

Rotation of crops should also be practiced, where possible.

Information concerning each of these pests and how to control them is given in the foregoing pages, and most of them are shown on plates I-VIII.